

REMARKS

Claims 1 and 4-24 remain pending in the present application, of which claims 15 and 17-22 were withdrawn from consideration as being drawn to a non-elected invention, while all remaining elected claims 4-14, 16, 23 and 24 were rejected again, this time on new grounds.

The Applicant has considered the non-final Office Action mailed April 1, 2008, but respectfully traverses the new grounds for rejection. Reconsideration and withdrawal of these rejections in light of the following remarks are respectfully requested.

Claim Rejections - 35 USC §112

Claims 1, 4-14, 16, 23 and 24 were rejected under 35 U.S.C. 112, first paragraph, for allegedly failing to comply with the enablement requirement. The Examiner contends that the claims contain subject matter that was not described in the specification in such a way to enable one skilled in the art to carry out the invention. The Examiner's position is that the claims should be restricted to the fibrous barrier web consisting of "hydrophobic fibers", since this feature appears to be essential to the practice of the invention and only this embodiment is disclosed in the Examples.

Applicant traverses this basis for rejection, in view of the amendment of claims 1 and 14 to include the word "hydrophobic" in the claim with respect to the barrier web. This amendment better defines what Applicant regards as his invention, even though it falls short of the amendment the Examiner calls for in his rejection. Support for this amendment is summarized in the table below. No new matter is added.

Claim	Support for Amendment
1	Original claim 2 + page 16, lines 10-22
14	Original claim 2 + page 16, lines 10-22

As provided in the specification on page 16, lines 10-22, hydrophobicity can be imparted by a couple of techniques. In one embodiment, hydrophobicity is derived from coating a hydrophilic fiber sheet with a hydrophobic coating. In another embodiment, hydrophobicity is derived by forming a sheet from hydrophobic fibers, which optionally can be further coated with a hydrophobic coating to impart additional hydrophobicity to the barrier layer. While the Examples show only using hydrophobic fibers to form the

barrier sheet (as pointed out by the Examiner), it is well established that Applicant need not exemplify every embodiment of the invention in order to claim a broader scope.

Since the Examiner has not advanced any reasons why the unexemplified embodiments would not work, Applicant asserts that the Examiner must accept the statement in the specification that they do work and are enabled. Withdrawal of the rejection is requested on this basis.

Claim Rejections – 35 USC § 103

Obviousness rejection 1

Claims 1, 4-9, 12-14, 16, 23 and 24 stand rejected under 35 U.S.C. §103(a) as allegedly being obvious over the disclosure of Clark et al. (US6723669) in view of Shawver et al. (US5695849). Applicant traverses this basis for rejection and respectfully requests reconsideration and withdrawal thereof, as the combination of references fails to fairly teach or suggest all elements of Applicant's claims.

The Present Invention

At the outset, the Applicant wishes to reiterate the patentable aspects of the present invention. Claim 1 of the present application requires the nonwoven fabric to have a novel combination of both high liquid barrier (hydrostatic head) and high air permeability (Frazier permeability) properties, i.e., hydroheads of between 145 and 400 cm and Frazier permeabilities between 0.3 and 11.2 m³/m²-min. This balance of improved properties is particularly important and advantageous for garments to be worn for long terms by workers involved in environmental cleanup, surgical operating rooms and the like.

Applicant has discovered a novel way to greatly increase hydrohead while preserving adequate air permeability of fabrics by combining a number of factors (some of which appear in the main claims and some of which appear in the dependent claims), including (1) the fabric composition (i.e., "hydrophobic"), (2) fiber size of the barrier layer fibers, (3) the basis weight of the barrier layer, (4) nature of the supporting substrate and (5) post-processing steps, such as calendaring to obtain particular fabric solids fractions.

It is generally well-known in the protective garment art that the properties of air permeability (which imparts comfort to the wearer) and hydrostatic head ("hydrohead",

which imparts protection to the wearer) are inversely proportional. That is, when a fabric is optimized for air permeability its hydrohead suffers, and vice versa.

In the present application, the Applicant has explored the physics involved in obtaining both maximum air permeability and maximum hydrohead and combined those investigations into a formula (claim 14) which allows those skilled in the art to design protective barrier fabrics having both good air permeability and good hydrohead, by varying a number of different controllable variables in nonwoven fabric manufacture. Thus, the Examiner will find Applicant's claimed invention is more than merely deposition a layer of sub-micron fibers onto a substrate.

The Deficiencies of Clark et al. and Shawver et al.

Turning to the rejection, the Examiner has taken the position that Clark et al. disclose a composite nonwoven fabric having a fibrous barrier layer made exclusively of sub-micron fibers, i.e., fiber having an average diameters of less than 1 micron (μ) (or nanofibers), as claimed in the present invention. Applicant respectfully disagrees with this view. While Clark et al. state that multi-component meltblown fibers of their invention may contain fibers having diameters ranging between 0.5μ and 10μ (see the paragraph bridging columns 3 and 4), which includes fibers in the submicron range, no actual examples of such exist, nor can such fibers be produced using the processes described Clark et al.

It is well known to those skilled in the art that conventional meltblowing processes such as those described in Clark et al. (column 9) were not able, at the time of this invention, to make nonwoven fabrics with fibers having average diameters less than 1μ , the practical lower limit of the technology. This point was made in the Rule 132 Declaration of Joseph R. Guckert filed in connection with a previous rejection where Dr. Guckert stated that melt-blowing dies such as those disclosed in Fabbricante et al. are incapable of producing nonwoven webs made of only sub-micron fibers. One skilled in the art would normally expect the fiber diameters for this technology to be in the normal size range, namely between 2μ and 10μ and at best between about 2μ and 5μ as disclosed in Clark et al.

Thus it is Applicant's position that this current reference does not enable one skilled in the art to produce fabrics made exclusively of sub-micron fibers (or nanofibers) and as such fails to disclose a key element of Applicant's claims.

Therefore, while the Examiner bases this rejection on the view that Clark et al. disclose all elements of independent claims 1 and 14 except for the very high hydrohead (i.e., liquid barrier) properties currently claimed, this position is inaccurate and not supported by a fair teaching of Clark et al., and for at least this reason, this obviousness rejection should be withdrawn.

It should be noted that Clark et al. also fail to disclose other elements of Applicant's claims.

The numbers reported in Clark et al. for air permeability and liquid barrier properties (i.e., hydrohead) are outside the claimed range, contrary to the Examiner's position. The Examiner has either misread or misinterpreted Clark's ranges.

Like traditional meltblown fabrics, because of the large (non nano) fiber sizes noted above, the meltblown fabrics in Clark et al. while capable of delivering very high air permeabilities, are incapable of achieving the extremely high hydroheads claimed, which property is desired for protective garments as discussed above.

The ranges reported in Clark compared to the claimed ranges (versus the Examiner's mistaken assertion) are summarized in the table below.

	Clark et al.	Claims 1 and 14	Examiner
Air Permeability	"about 100 CFM or more" $(\geq 30.5 \text{ m}^3/\text{m}^2\text{-min})$ (column 4, lines 32-33)	$0.3\text{-}11.2 \text{ m}^3/\text{m}^2\text{-min}$	"up to and beyond 100 CFM" $(0\text{-}30.5+ \text{ m}^3/\text{m}^2\text{-min})$ Office Action at Page 3
Hydrohead	"in excess of about 80 mbars" $(> 82\text{cm})$ (column 13, lines 4-5)	$145\text{-}400 \text{ cm !!!}$	"up to and beyond 80 mbars" $(0\text{-}82+ \text{cm})$ Office Action at Page 3

The air permeability and hydrohead properties of the Clark et al. examples are also plotted below, which are overlayed on Figure 1 of the present application. Clearly in terms of hydrohead, these results are well within, and in fact, well below the expectations for meltblown webs, but are order(s) of magnitude below the hydroheads claimed. While there is no upper limit specified for Clark et al.'s hydrohead values, when

one skilled in the art looks at the specifics of their examples, it is clear that Clark et al. would not be able to meet the very high liquid barrier properties, as claimed in the present application. Thus Clark et al. clearly do not anticipate the achievements of the present invention nor do they suggest any means to improve hydroheads in the very high range claimed.

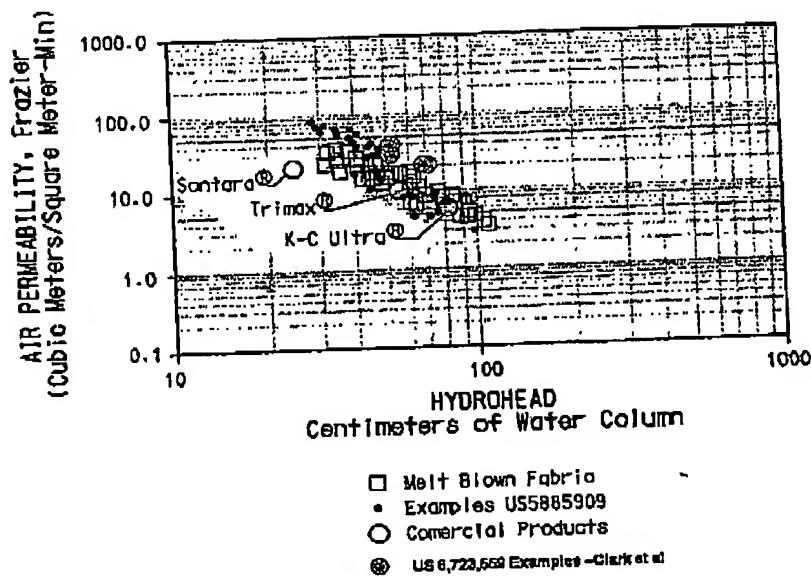


FIG. 1

The secondary reference cited by the Examiner fail to fill in the gaps noted above in the teachings of Clark et al. Even if one were to attempt to combine the teachings of Clark et al. with Shawver et al. in the manner suggested by the Examiner, the combination would still fail to make up for the claim deficiencies noted above in Clark et al. Shawver et al., like Clark et al., wholly fail to invite the use of any sort of nanofiber (contrary to the Examiner's belief) and entirely fail to address the problem at hand, i.e.,

providing high liquid barrier properties in a nonwoven fabric without entirely sacrificing air permeability and comfort to the wearer.

Shawver et al. disclose just another example of fabric made of meltblown fibers having diameters in the traditional above 2μ meltblown technology range (see column 2, lines 9-10). Even though Shawver et al., like Clark et al., mention the possibility of the fibers having diameters in the submicron range (i.e., 0.5μ and above), meltblown fiber technology at the time of the invention was not able to make nonwoven fabrics with fibers having average diameters below 1μ , the practical lower limit of the technology. Thus Shawver et al. fail to supply the missing element in the primary reference to arrive at Applicant's invention.

Furthermore, even assuming the Examiner still views some combination provided above as suggesting the invention claimed, there is no suggestion or reasonable expectation that proposed combination could even achieve the greater than expected results claimed. While the Examiner would like to combine Shawver et al. to say that hydrohead is easily raised using hydrophobic fibers to the values claimed, there is no reasonable expectation to believe that the results of the present invention could ever be achieved, especially by only using traditional meltblown fibers as described in both Clark et al. and Shawver et al.

Shawver et al. clearly desire to have some liquid barrier properties (hydrohead) for their fabrics which are intended for use in baby diapers, and it appears they employ a hydrophobic polyolefin polymer for such purpose. However, Shawver et al. also recognize that their hydroheads, although sufficient for their purposes, are "not exceedingly high" (see column 6, lines 50-54) and as such are only able to achieve hydroheads of about 4 mbars (4.2 cm), with the hydroheads reported in the examples being 5.2 mbars (5.4 cm) and 7.2 mbars (7.4 cm) respectively. This is obviously well below the extremely high 145-400 cm hydrohead range claimed and even below Clark's reported range.

While arguably at best, Shawver et al. might be considered as teaching that using fibers derived from hydrophobic polymers can improve hydrohead of meltblown fabrics such as those disclosed in Clark et al., there is no reasonable expectation that such processing would lead to extraordinary improvements in hydrohead of the orders of magnitude claimed. The results of Clark et al. examples reported above in FIG. 1 above

clearly would not lead one skilled in the art to expect the level of claimed hydroheads even with hydrohead enhancing improvements as taught by Shawver et al., nor would the Shawver et al. examples. Thus, there is no reasonable expectation that such results could ever be achieved, while at the same time preserving adequate air permeability.

Even assuming the Examiner still views some combination provided above as suggesting the invention claimed – which it does not – and believes the *prima facie* case of obviousness has been made – which it has not - Applicant also calls attention to the **surprising and unexpected** results achieved with the present invention. Such evidence must be considered by the Examiner and clearly establishes that Applicant's invention was in fact not obvious to one of ordinary skill in the art at the time of the invention and can be used to rebut any *prima facie* case of obviousness suggested by the Examiner. See MPEP § 716.01(a) and § 716.02(a).

Each independent claim of the present application (claims 1 and 14) specifies a composite nonwoven fabric with an unusual combination of high liquid barrier (hydrohead) **AND** high air permeability (Frazier permeability). Applicant has clearly discovered a novel way to greatly increase liquid penetration resistance while preserving adequate air permeability of fabrics intended for use in protective garments. Nowhere in the prior art is there a conception of achieving both high liquid barrier (hydrohead) **AND** high air permeability (Frazier).

As discussed in the Rule 132 declaration of the present inventor, Dr. Michael Bryner, this combination of properties was not only nonobvious but also **unexpected** and **addressed a long felt need** in the art which provide indicia that the invention was clearly nonobvious. The evidence was created to rebut an obviousness rejection over much closer prior art than what is currently being applied against the present claims, and should be given at least as much weight herein. It is urged that this objective evidence that is proffered against obviousness must be considered here by the Examiner, and, in the face of such evidence, all remaining rejections under 35 USC § 103 should be reconsidered and withdrawn on this basis as well.

Excerpts from page 8 of Dr. Bryner's Rule 132 Declaration are provided below.

10. Unexpected Results over Closest Prior Art of Doshi

10.1 Even if, for the sake of argument, one skilled in the art could reasonably have been expected to be able to optimize both hydrohead and air permeability together, nothing in the prior art would lead to the expectation of the unique combinations of hydrohead and Frazier demonstrated in the claimed invention.

10.2 In Example 10 of this application, I report a fabric with a Frazier permeability of $11.2 \text{ m}^3/\text{m}^2\text{-min}$ ($38.7 \text{ ft}^3/\text{ft}^2\text{-min}$) with a hydrohead of 131 cmw_c (128 mbar). This is 22X the air permeability and almost 9X (8.9X) the hydrohead of Doshi's best sample. My highest barrier sample at 399 cmw_c (391 mbar) has ~30X the hydrohead of Doshi's samples and it still has higher Frazier permeability – $0.7 \text{ m}^3/\text{m}^2\text{-min}$ ($2.3 \text{ ft}^3/\text{ft}^2\text{-min}$), i.e., still 1.4X Doshi's sample. A priori expectation of these results based on the prior art is unreasonable.

11. Long Felt Need/Failure of Others

11.1 I submit that at the time of the invention there were no known fabrics of the type of the invention having hydrohead and air permeability in the range demonstrated and claimed herein. Further, I believe that the demonstration of this invention was the first such demonstration in recorded history of these particular combinations of high hydrohead and high air permeability using polymeric nanofiber based fabrics.

11.2 Additionally, in the time since this application was filed, in spite of the commercial desirability of this combination of properties as set forth in this application, and in spite of the growth in the field of nanofiber based fabric offerings, I know of no other disclosure outside of DuPont wherein a polymeric nanofiber composite has achieved the unique balance of properties achieved and claimed in this application.

11.3 I submit that this is evidence of long felt need for my invention, in combination of the failure of others to achieve the goals set forth in the claims.

For all the forgoing reasons, the present invention as currently claimed should be deemed nonobvious and patentable over the prior art, as no combination of references fairly teach or suggest all elements of Applicant's claims, and any such combination would not have been expected to achieve the extraordinary results achieved by the present invention.

Furthermore, with regard to claim 4, Applicant respectfully traverses this obviousness rejection for at least the same reasons mentioned above, and in addition,

the Examiner apparently misreads or misinterprets Clark et al. (the paragraph bridging columns 3 and 4). Claim 4 recites:

The nonwoven fabrics of claim 1 wherein said barrier web fibers have diameters of less than 0.5 micrometer.

Clark et al. disclose no fibers less than 0.5μ whatsoever. As discussed, Clark et al. mention fibers greater than 0.5μ in diameter and within the practice of meltblowing this in reality means fiber diameters greater than 1μ . Since Clark et al. fail to describe fibers in this nanofiber range claimed, Clark et al. fail to disclose all elements of current claim 4 and Shawver et al. fail to make up for this deficiency. Accordingly the *prima facie* case of obviousness has not been set forth against claim 4 and should be withdrawn for this additional reason. Claim 4 is thus separately patentable as this particular combination using nanofiber webs of this fiber diameter while still retaining adequate air permeability has not heretofore been disclosed or suggested.

Furthermore, with regard to claims 5, 13 and 23-24, these claims should also be deemed separately patentable as the claimed additional features of, for example, providing a certain barrier layer basis weight (claim 5) and a certain solids fraction (claim 13) and a certain fiber size support structure (claim 23) to optimize the balance of air flow and liquid penetration resistance has never been disclosed in the manner claimed, nor has there been any suggestion of any benefit to be gained thereby.

For all these additional reasons, the nonobvious rejection relative to the above dependent claims should be withdrawn on this basis as well.

Lastly, to suggest that one skilled in the art would modify any of the references cited in the manner suggested by the Examiner is strictly based on unsupported speculation, motivated only by Applicant's specification, not by the art itself, and all obviousness rejections noted above should be withdrawn on this basis as well.

Obviousness Rejection 2

Claims 10 and 11 stand rejected under 35 U.S.C. §103(a) as allegedly being obvious over the disclosure of Clark et al. (US6723669) in view of Shawver et al. (US5695849) as applied to claims 1, 4-9, 12-14, 16, 23 and 24 above, and further in view of Benson et al. (US6,746,517). Applicant traverses this basis for rejection and

respectfully requests reconsideration and withdrawal thereof, as this combination of cited references similarly fails to disclose or fairly suggest all elements of Applicant's claims.

The Deficiencies of Clark et al., Shawver et al. and Benson et al.

As noted above, the combination of Clark et al. and Shawver et al. fail to arrive at the present invention. The failings of Clark et al. and Shawver et al. have been discussed in detail above. They are reiterated here. In brief, neither reference invites use of nanofibers (let alone use of nanofibers exclusively) or composite nanofiber webs made therefrom nor do they suggest any means for balancing good air flow with good liquid penetration resistance, for use in protective garments.

The Examiner relies on Benson et al. for its disclosure of coating fibers with a hydrophobic coating to provide such balance. However, nothing in Benson et al. would cure the underlying deficiencies of Clark et al. and Shawver et al. While Benson et al. mention adding a hydrophobic material to a nanofiber web to increase its humidity resistance when used as an air filter media, even if you pick out this feature of Benson et al. and add such hydrophobic material to a meltblown fabric as described in Clark et al., because of the large meltblown fiber size, you would not have any reasonable expectation to shift the low hydrohead of the Clark et al. composites to the range demonstrated by the present invention.

Accordingly the combination of all three references in the manner suggested by the Examiner fails to arrive at the present invention, as all of Applicant's claim limitations are not taught or suggested.

Also, as stated in a prior response, the passage of Benson that is cited by the Examiner (col. 12, lines 47-67) does not teach coating a nanofiber web with a hydrophobic coating, but instead teaches mixing a hydrophobic additive into the fiber-forming polymer, prior to fiber formation. As such, even if combined in the manner suggested by the Examiner, Benson et al., Clark et al. and Shawver et al. fail to teach all the limitations of claims 10 and 11.

Therefore, Applicant submits that even in combination, Clark et al., Shawver et al., and Benson et al. cannot be deemed to make obvious the present claims. Withdrawal of the rejection is requested on this basis.

Additionally, as discussed in a prior response where Benson was used by the Examiner to reject earlier claims, Applicant pointed out that one cannot hold that the properties of nonwoven fabrics created for air filtration end uses are the same as or predictive of fabrics created to act as liquid barriers. The object of an air filter is to provide maximum air flow through the media and not to provide a barrier to liquid penetration. It is not reasonable to assume that air filtration can be presumed to apply liquid barrier performance. Thus, Applicant still asserts that Benson et al is irrelevant (non-analogous) to the present invention and as such is not properly combinable with any of the other references cited above. Any art that describes use of nonwoven fabric air filters having barrier properties against particulates renders hydrohead properties irrelevant to this media, and should not be used as a basis to reject any of the present claims.

For all the additional reasons presented above, the nonobvious rejection relative to the above dependent claims should be withdrawn.

Lastly, to suggest that one skilled in the art would modify any of the references cited in the manner suggested by the Examiner is strictly based on unsupported speculation, motivated only by Applicant's specification, not by the art itself, and all obviousness rejections noted above should be withdrawn on this basis as well.

Conclusion

In view of the above remarks, the pending case is believed to be in condition for allowance. If the Examiner should believe that anything further may be required to place this application in even better form for allowance, he is cordially invited to telephone the undersigned attorney for Applicant.

Respectfully submitted,


STEVEN C. BENJAMIN
ATTORNEY FOR APPLICANT
REGISTRATION NO. 36,087
TELEPHONE: 302-992-2236
FACSIMILE: 302-992-2533

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